Optically-induced photonic lattices: an analog of nonlinear photonic crystals

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We present an up-to-date overview of both theoretical and experimental results on the physics of one- and two-dimensional nonlinear photonic lattices induced optically in photorefractive crystals. Such optically-induced linear and nonlinear photonic lattices provide an ideal test-bed for demonstrating many novel nonlinear phenomena in photonic periodic structures, due to their dynamical tunability and strong nonlinear effects that can be observed at moderate laser powers, thus studying the basic properties of nonlinear photonic crystals as building blocks for future all-optical switching technologies. Using these optically-induced lattices, we were able to observe experimentally both linear and nonlinear Bragg scattering [1], the formation of optical spatially localized structures in the form of self-trapped lattice solitons and spatial gap solitons [2] creating by self-focusing of Bloch waves, as well as novel types of optical vortices in lattices [3]. We have also generated multi-gap states belonging to different spectral gaps. We have demonstrated interaction and steering of gap solitons, which are the key features for a new type of light controlling devices based on periodic photonic structures, including nonlinear photonic crystals.

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